(12) UK Patent Application (19) GB (11) 2 352 887 (13) A

(43) Date of A Publication 07.02.2001

(21) Application No 0014698.5

(22) Date of Filing 15.06.2000

(30) Priority Data
(31) 2275041 (32) 17.06.1999 (33) CA

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(51) INT CL[7]
H02J 9/06 // H02J 7/00 , H04M 1/73

(52) UK CL (Edition S)
H2H HAJ HBCA HBCH
H4L LECTX L1H3

(56) Documents Cited
GB 2279827 A EP 0433605 A2 US 5912514 A
US 5801513 A

(58) Field of Search
UK CL (Edition R) H2H HAJ HBCH , H4L LECTX
INT CL[7] H02J 7/00 7/34 9/00 9/04 9/06 , H04B 1/16 , H04M 1/73
Online : WPI, EPODOC, PAJ

(54) Abstract Title
Cordless phone with battery backup

(57) A cordless telephone includes a base unit 300 and a handset 400, the base unit can be powered by primary power source 102 or in the event of a power cut by backup battery B1. The handset is powered by battery B4 which is charged when the charging terminal 243 is placed in contact with the base unit terminal 143 or alternatively using a non-contact arrangement (L500, L600 figure 8). In the event of a power failure an alarm circuit 120 alerts microprocessor U303 which will then operate the base circuitry from the battery. If during the power failure the handset battery becomes depleted then the microprocessor can use power from the backup battery to charge the handset battery.

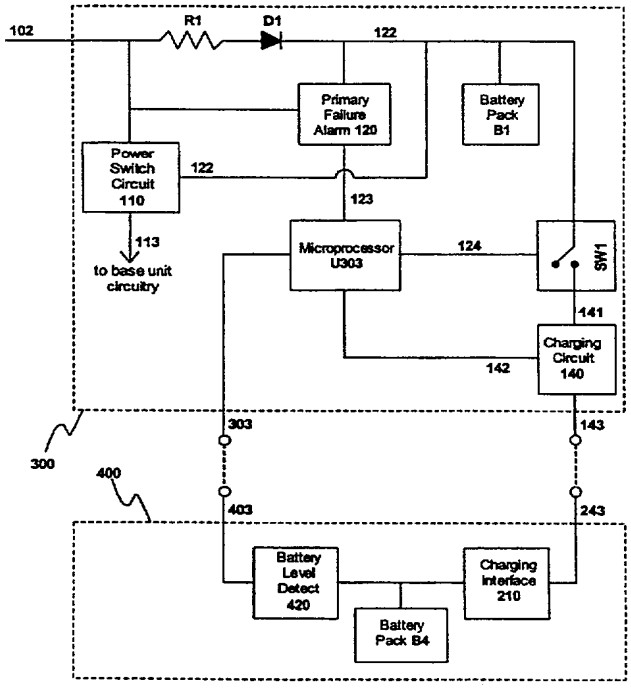

Figure 7

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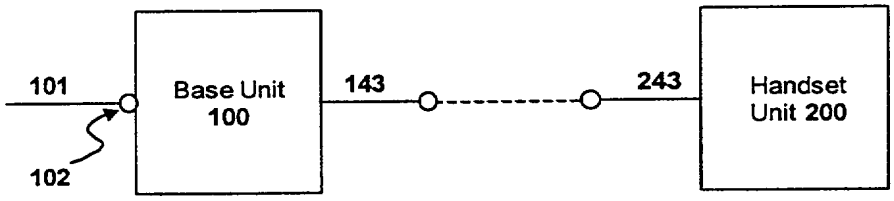

Figure 1

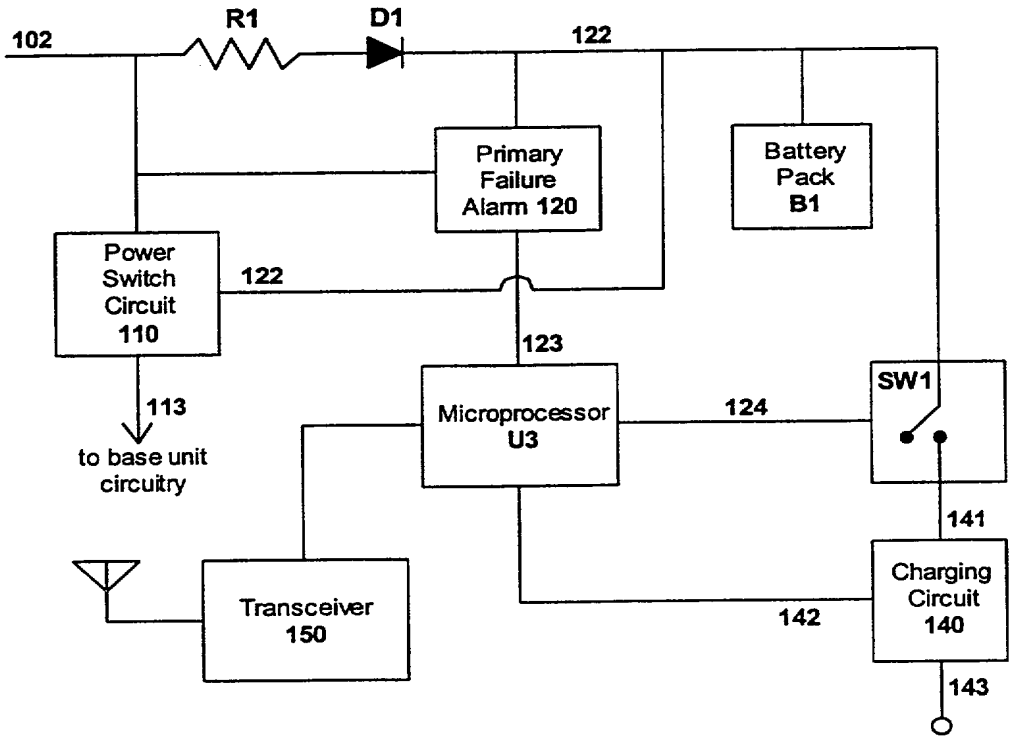

Figure 2

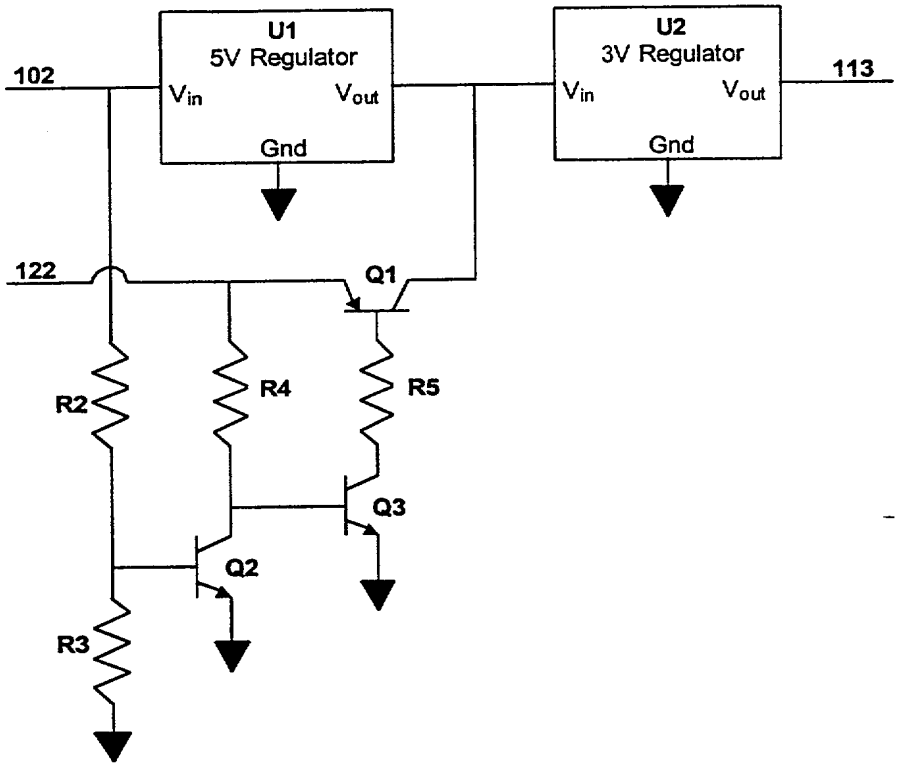

Figure 3

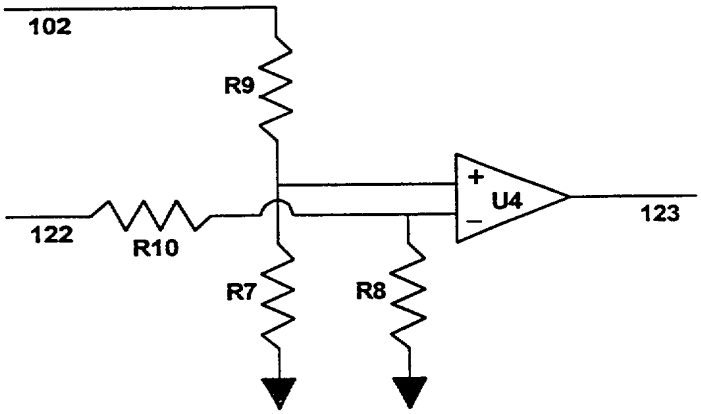

Figure 4

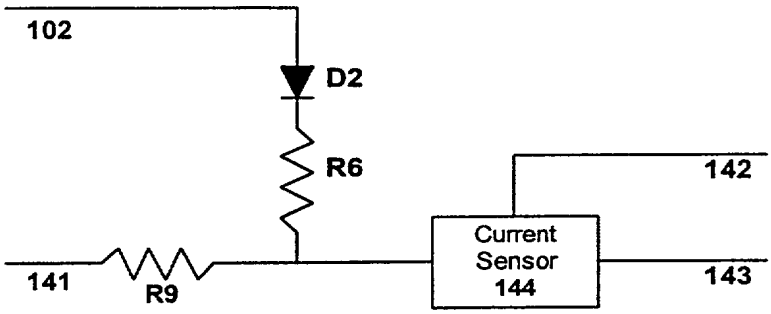

Figure 5

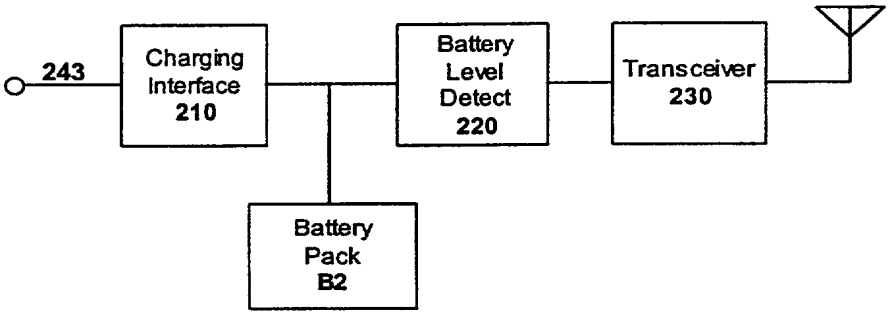

Figure 6

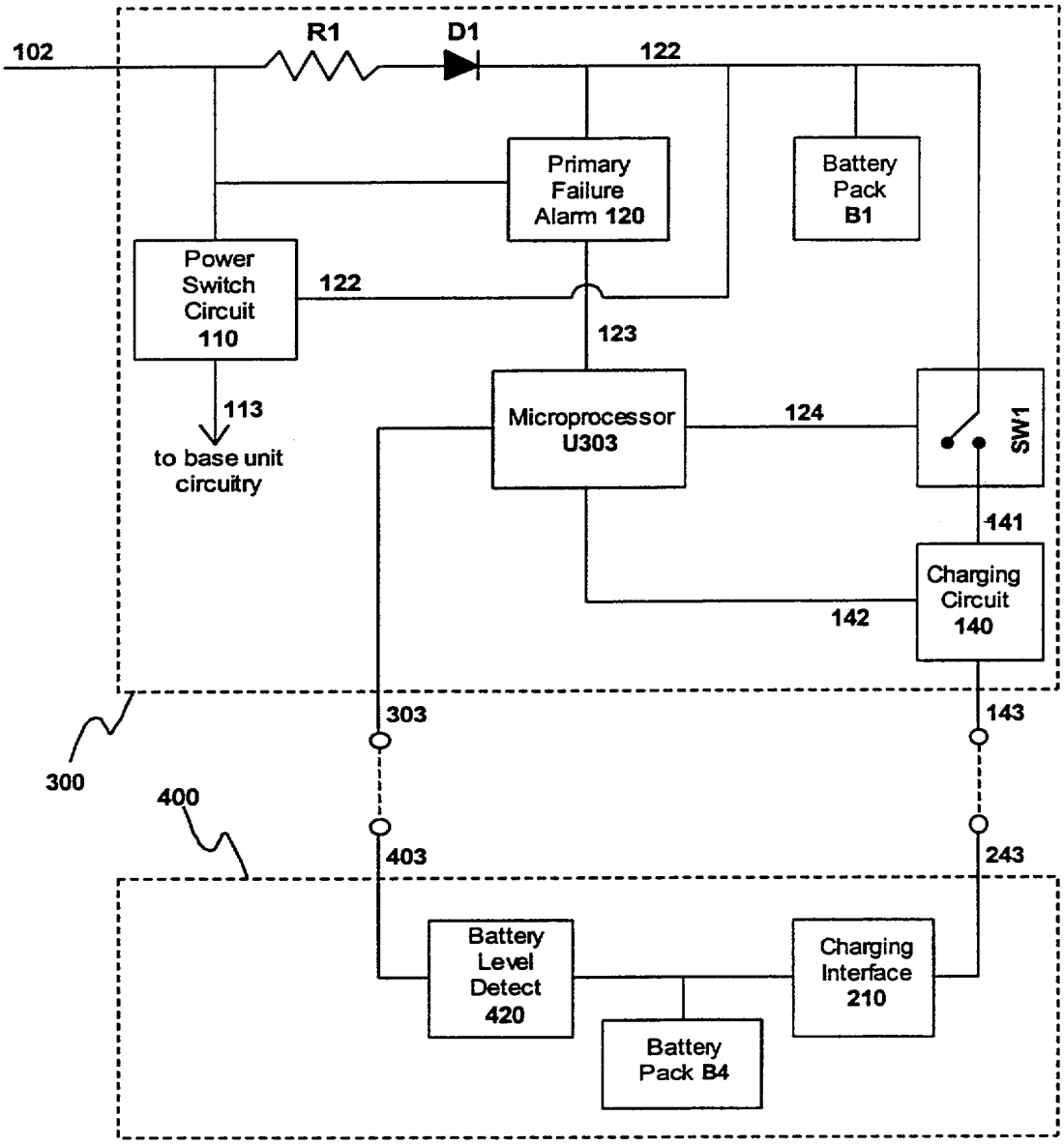
102
R1
D1
122
Primary Failure Alarm 120
Battery Pack B1
Power Switch Circuit 110
122
123
113
to base unit circuitry
Microprocessor U303
124
SW1
141
Charging Circuit 140
142
300
303
143
400
403
243
Battery Level Detect 420
Charging Interface 210
Battery Pack B4

Figure 7

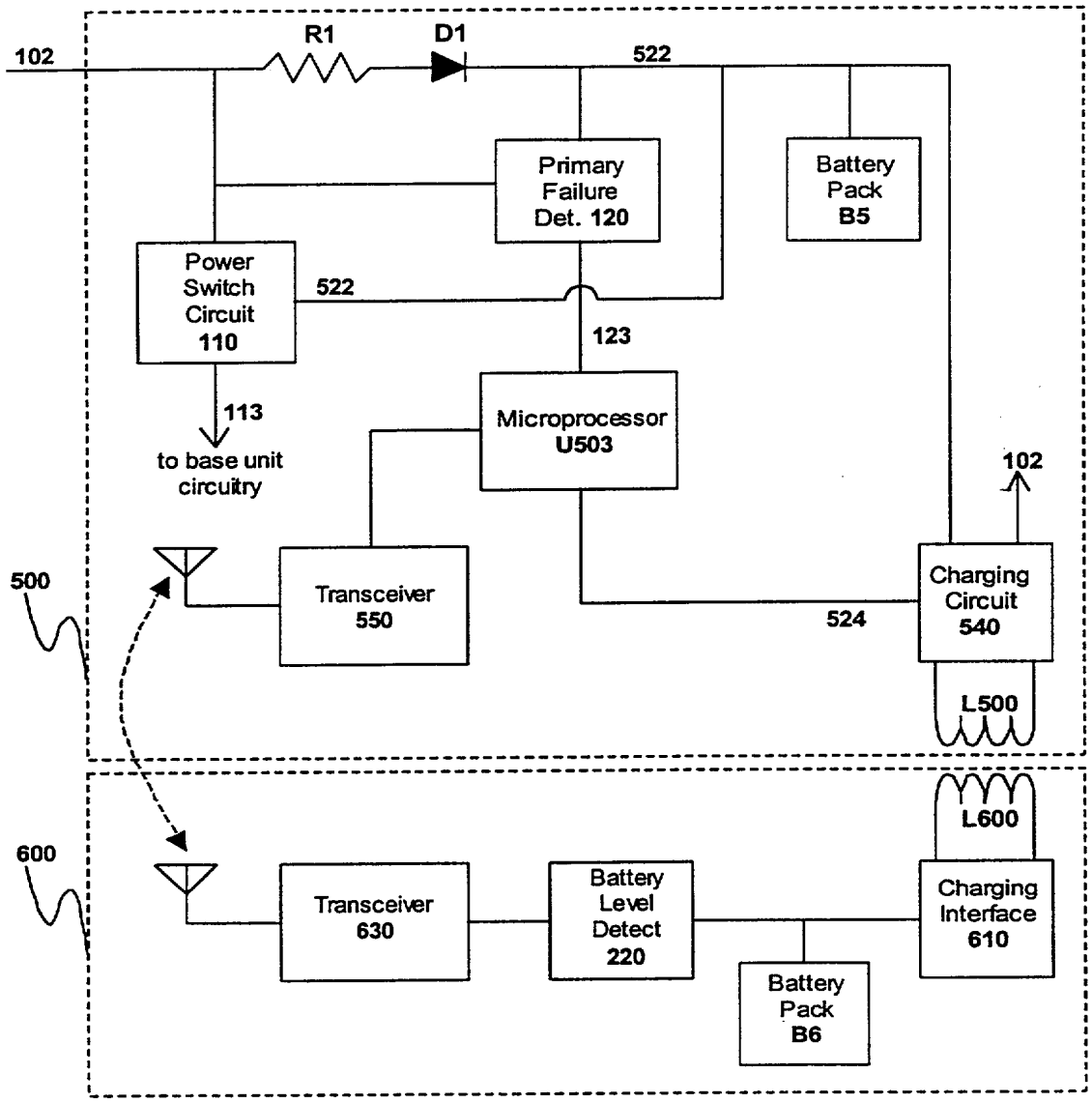
102
R1
D1
522
Primary Failure Det. 120
Battery Pack B5
Power Switch Circuit 110
522
123
113
to base unit circuitry
Microprocessor U503
102
500
Transceiver 550
524
Charging Circuit 540
L500
L600
600
Transceiver 630
Battery Level Detect 220
Charging Interface 610
Battery Pack B6

Figure 8

TITLE OF THE INVENTION

Method And Apparatus Of Extending Useful Life Of A Cordless Telephone During a Power Outage Condition

BACKGROUND OF THE INVENTION

Cordless telephones have become a common fixture in the modern household, to the extent that they now often constitute the sole household telephone device for many consumers. Consumers have found it quite desirable to have a portable wireless handset unit which may be moved about, often great distances from the stationary baseset unit which is electrically connected to the telephone company network. While the convenience, mobility, and high sound quality of the battery operated wireless handset unit has attracted many consumers, one drawback of common cordless telephones is that they require more electrical power than can be provided via a conventional telephone line and consequently, cordless telephones, specifically the baseset unit, must be connected to a household power outlet for operation. The external electric power source serves to power the radio module and other circuitry located in the baseset unit toward being able to communicate with the battery operated portable handset unit as well as toward being able to recharge the handset battery when the handset unit is returned to its charging cradle located within the baseset unit.

One significant drawback of such externally powered cordless telephones is that they commonly become inoperative during a power outage since even though the handset unit battery may still contain sufficient charge to operate the baseset unit typically ceases to operate when the external power source is interrupted. If the telephone consumer does not also own a conventional corded telephone that operates

on telephone line power alone, the consumer is unable to place a telephone call to report the power outage or, more importantly, to summon assistance in emergency situations. As a result, consumers must keep an unwanted and inconvenient corded telephone in service, or risk completely losing telephone service in the event of a power outage.

At least one prior art cordless telephone design has addressed this shortcoming by incorporating a rechargeable battery pack in the cordless telephone baseset unit which can temporarily provide electoral power to the base unit when the external power supply fails. With such a prior art device the consumer may continue to use the cordless telephone to both receive and initiate telephone calls during a power outage for as long as both the handset unit and baseset unit internal batteries retain sufficient electrical charge to operate the handset and baseset units, respectively.

While the backup battery located in the baseset unit is typically at its maximum charge state given its continued connection to the external source of electrical power, the handset unit, however, is not typically at a full charge state when a power outage occurs given that consumers commonly utilize a cordless telephone handset in its mobile capacity, and consequently typically store the handset in locations other than on the baseset recharging cradle. Thus when a power outage occurs, the handset battery will commonly be discharged to varying degrees while the base unit battery is often fully charged. Consequently, the handset battery may become fully discharged long before the base backup battery, and backup battery power feature provided by the baseset unit cannot be optimally utilized.

It is therefore an object of this invention to maximize cordless telephone utilization time in the event of a power outage.

These and other objects of the present invention will become apparent in light of the present specification and drawings.

SUMMARY OF THE INVENTION

The invention involves a base unit and a portable unit, each capable of operating from a rechargeable battery pack as a power source. The base unit is further capable of operating on power supplied by an external source, such as a wall outlet and AC to DC converter.

The base unit normally charges the portable unit battery pack by applying energy from the external power source. Energy can be applied to the portable unit either by an electrically conductive connection, or through inductive coupling. When the external power source fails, both the base unit and portable unit continue operation on their respective battery pack power sources. If the portable unit battery nears depletion, the invention can act to transfer energy from the base unit to the portable unit.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of one embodiment of the invention, showing the relationship between the base unit and handset unit.

Fig. 2 is a schematic block diagram of one embodiment of the base unit power supply circuit.

Fig. 3 is a schematic block diagram of the power switch circuit, which selects between a primary power source and a secondary power source to provide uninterrupted output voltage to the base unit circuitry.

Fig. 4 is a schematic diagram of a primary power supply failure alarm circuit.

Fig. 5 is a schematic block diagram of one embodiment of the charging circuit.

Fig. 6 is a schematic block diagram of one embodiment of the handset unit.

Fig. 7 is a schematic block diagram of a second embodiment of the invention, in which the status of the handset battery is communicated via a conductive contact.

Fig. 8 is a schematic block diagram of a third embodiment of the invention in which the handset is charged via an inductive charging system.

DETAILED DESCRIPTION OF THE INVENTION

While this invention is susceptible to embodiment in many different forms, there are shown in the drawings and will be described in detail herein several specific embodiments, with the understanding that the present disclosure is to be considered as an exemplification of the principle of the invention and is not intended to limit the invention to embodiments illustrated. Furthermore, while the invention is described in the context of a cordless telephone system, it is envisioned that the invention could be incorporated into any electronic device comprised of a first portable battery-powered unit and a second externally powered unit with battery backup.

In the embodiment of Figure 1, base unit 100 is shown connected to external electrical line power 101 at the primary power source input, terminal 102. In this embodiment, approximately +9VDC is applied to terminal 102, typically converted from a wall outlet AC voltage by an AC to DC converter (not shown) which can be either external to the base unit or internal. Base unit 100 can be operably electrically connected to or disconnected from handset unit 200 via contacts 143 and 243, respectively. Contacts 143 and 243 may be comprised of one of a number of possible means of coupling electric energy, such as direct electrical conduction or inductive coupling, as further described hereinbelow.

Figure 2 depicts one embodiment of the power circuitry within base unit 100. During normal operation, when the primary external electrical power source 101 is present, current flows into terminal 102 to power switch circuit 110. Power switch circuit 110 regulates the voltage to a desired level, and passes electrical current via output

113. Output 113 provides power to the additional circuits which comprise the wireless telephone base unit.

The primary power source at terminal 102 also charges base unit battery pack B1 during normal operation. Current from terminal 102 flows through current-limiting resistor R1 and diode D1. Diode D1 prevents the reverse flow of current from battery B1 to terminal 102 in the event of a failure of the primary power source 101 thereby preventing electrical charge stored within battery B1 from being dissipated.

The embodiment of Figure 2 includes primary power failure alarm circuit 120, shown in Figure 4. Alarm circuit 120 is comprised of comparator U4 and resistors R7, R8, R9, and R10. The values of the resistors are chosen so that the comparator U4 output occupies a first state when voltage from the primary power source 101 is present at terminal 102, and a second state when the primary power source 101 voltage is not present and voltage from battery pack B1 is present. Comparator output 123 is connected to microprocessor U3, whereby U3 detects whether voltage from the primary power source 101 is present, such as during normal operation, or absent, such as during a power outage. While the illustrated embodiments utilize a microprocessor to detect the presence of the primary power source, it is also envisioned that this function, as well as the additional functions that are assigned to the microprocessor and described herein, can optionally be implemented by other means, including discrete logic circuits and/or ASICs.

Figure 3 shows one embodiment of power switch 110. During normal operation, when the primary power source 101 is present on terminal 102, regulator U1 regulates the terminal 102 voltage down to +5VDC. The +5VDC is applied to regulator U2, which

further regulates down to a +3VDC output voltage. The output of regulator U2 is applied to terminal 113 for powering base unit circuitry.

Power switch circuit 110 of Figure 3 also acts to automatically switch between the primary (line) 101 and secondary (B1) base unit power sources. It is comprised of transistors Q1, Q2, and Q3, along with resistors R2, R3, R4, and R5. When proper voltage is present at terminal 102, regulator U2 receives current solely from terminal 102 through U1. The voltage present at 102 turns on Q2, which pulls the base of Q3 low, thereby turning Q3 off. With Q3 pulling no current from the base of Q1, Q1 is turned off, disconnecting regulator U2 from battery connection 122.

When the primary power source voltage at terminal 102 is removed such as during a power outage, Q2 is turned off. Battery connection 122 biases the base of Q3, causing it to pull current from the base of Q1. Q1 is thereby turned on. Battery B1 supplies current to regulator U2 (and consequently the remaining base circuitry) through connection 122 and transistor Q1.

The handset battery is charged by charging circuit 140 via connection 143. Figure 5 shows one possible embodiment of charging circuit 140 when connection 143 consists of a conductive electrical connection. Connection 143 in this embodiment consists of electrically conductive terminals on base unit 100, which are designed to operatively engage associated electrically conductive terminals 243 on handset 200 when handset 200 is placed in a predetermined position adjacent to base unit 100. During normal operation, when voltage from the primary power source is present at terminal 102, current flows from terminal 102 through diode D2, current limiting resistor R6, and current sensor 144 to handset connection 143. Current sensor 144 provides a

signal on output 142 to microprocessor U3 indicating whether or not current is flowing to terminal 143, and hence whether or not a handset is in an engaged position and capable of being charged. Current from terminal 102 does not flow backwards into line 141 through R9 because switch SW1 is in the open position.

Figure 6 shows handset circuitry related to charging battery B2. Charging interface 210 connects terminal 243 to battery B2, providing any interface circuitry that is desired. For example, interface 210 may comprise a series resistor, thereby providing a current-limiting function. Interface 210 could alternatively consist of a constant current source, or include overvoltage or electrostatic discharge protection, or other circuitry as required for a particular design. Such circuits for charging rechargeable battery packs are well known in the art.

Upon failure of the primary power supply, output 123 of primary failure alarm 120 changes from a first to a second state, thereby indicating to microprocessor U3 that the primary power supply has failed. Power switch circuit 110 switches base unit operation from primary power source 101 operation to backup battery operation by turning on transistor Q1. Thereafter, both base unit 100 and handset 200 operate on battery power. When the remaining energy level in handset battery B2 falls below a threshold level, the handset can request that the base unit transfer electric energy from base battery B1 to handset battery B2. One possible way in which the request can be made is shown in the embodiment of Figure 6, where battery level detect circuit 220 indicates the low state of battery B2 to handset transceiver 230. Handset transceiver 230 then transmits a wireless data message, which is received by base unit transceiver 150 (shown in Figure 2.) Transceiver 150 relays the request to microprocessor U3.

When microprocessor U3 receives an indication that both 1) the primary power supply has failed, and 2) the handset battery energy level is low, microprocessor U3 closes switch SW1 by toggling the state of connection 124. When SW1 is closed, current flows from base battery B1 into charging circuit 140. The current flows through current limiting resistor R9 and current sensor 144 to terminal 143, where the current can be conducted into the handset charging interface.

One method of controlling the amount of energy that is transferred from base battery B1 to handset battery B2 is by a timer function integral to microprocessor U3. In such an embodiment, U3 detects the initiation of current flow from B1 to B2 by the state of current sensor output 142. U3 can then keep switch SW1 in the closed position for a predetermined period of time before toggling the state of line 124, thereby opening switch SW1. Other methods of controlling the amount of energy transferred from B1 to B2, such as integrating current flow or monitoring voltage levels, can be easily implemented and are considered to be within the scope of the invention.

Other methods may also be used by the handset to notify the base unit that the handset battery requires charging. For example, Figure 7 depicts an embodiment in which the handset's request for energy transfer is conveyed by an electrically conductive connection that is engaged when handset 400 is placed in a predetermined position adjacent to base unit 300. In this embodiment, rather than conveying a wireless radio message from the handset transceiver to the base transceiver to signal a low battery condition, handset battery level detect 420 detects the energy level of battery B4 and toggles the state of line 403, which is conducted onto line 303 (when the handset is in position) and received by microprocessor U303. Alternatively, the handset

could transmit an indication of the remaining energy in the handset battery, such that the base unit can determine when an energy transfer should occur. The base unit could make this determination based upon, for example, the energy levels remaining in both the handset battery and base battery.

Different methods of charging the handset battery are also envisioned, and considered within the scope of the invention. For example, the embodiment of Figure 8 utilizes an inductive charging system, whereby handset 600 does not necessarily need to be in physical contact with base unit 500, but rather must only be positioned proximately to base unit 500. Such a charging system eliminates charging problems that might occur when a handset is left slightly ajar on the base unit, or when electrical contacts become dirty. In this embodiment, charging circuit 540 is placed into an activated or deactivated state depending upon the state of line 524 from microprocessor U503. When charging circuit 540 is in an activated state, it draws DC current in, and energizes inductive coil L500. When voltage from the primary power source 101 is present on terminal 102, charging circuit 540 draws current from 101. If the primary power source 101 has failed and U503 activates charging circuit 540, circuit 540 draws DC current from base battery pack B5 through line 522. The magnetic field generated by L500 is coupled onto handset coil L600 when the handset is positioned proximately to the base unit. Handset charging interface 610 converts the coupled energy into a DC current, which operates to charge battery pack B6 and power the handset circuitry. This inductive charging system embodiment of Figure 8 can determine when the handset is proximately positioned, and hence when a charge transfer can take place, by performing "test bursts" to determine the coupling efficiency between L500 and L600.

For example, transceivers 550 and 630 can communicate to coordinate a predetermined energy pulse on L500, which can be compared to the received energy pulse on L600 to determine the coupling efficiency. Charging would typically only take place when the coupling efficiency exceeds a minimum threshold level.

The foregoing description and drawings merely explain and illustrate the invention and the invention is not limited thereto except insofar as the appended claims are so limited, inasmuch as those skilled in the art, having the present disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

I claim:

1. A method for providing electrical power to an electronic apparatus, said apparatus including a first unit and a second portable unit, said first unit being capable of operating on either a primary power source or a first battery associated with the first unit, said second unit being capable of operation on a second rechargeable battery associated with the second unit, which method comprises the following steps:

- detecting by the first unit the failure of the primary power source;
- operating the first unit with power supplied by the first battery;
- determining that energy should be transferred from the first battery to the second battery;
- transferring electrical charge from the first battery to the second battery.

2. The method of claim 1, in which the step of transferring electrical charge from the first battery to the second battery further includes the substeps of

- placing the second unit into electrical contact with the first unit;
- conducting electrical current between the first unit and the second unit;
- storing the conducted electric energy in the second battery.

3. The method of claim 1, in which the step of transferring electrical charge from the first battery to the second battery further includes the substeps of

- placing the second unit in close proximity to the first unit;
- coupling energy inductively from the first unit to the second unit;
- storing the inductively coupled energy in the second battery.

4. An electrical apparatus comprising

- a base unit;
- a portable unit;
- a first battery pack contained within the base unit;
- a second battery pack contained within the portable unit;
- means for applying direct current power to the base unit from an external source;
- a controller circuit;
- a power alarm circuit contained within the base unit which circuit's output indicates to the microprocessor circuit whether power is being applied by the means for applying;
- a unidirectional current control circuit connecting the means for applying direct current to the first battery pack;
- a power switch circuit which provides current to the base unit circuitry from either the means for applying if active, or else the first battery pack;
- means for charging the second battery pack, said means residing within the base unit;
- an electronically-controlled switch connecting the first battery pack to the means for charging the second battery pack, the switch state being controlled by the microprocessor circuit;

- a charging interface circuit disposed within the portable unit, said interface circuit being operably connected to both the means for charging the second battery pack, and the second battery pack;
- a battery level detection circuit electrically connected to the second battery pack, which level detection circuit provides an indication when the charge stored within the second battery pack falls below a threshold level;
- means for indicating to the base unit the status of the battery level detection circuit, said means being disposed within the portable unit.

5. The apparatus of claim 4, in which the means for charging the second battery pack includes a first set of electrically conductive contacts, and the charging interface circuit includes a second set of electrically conductive contacts, said first and second sets of contacts forming an operable connection when the portable unit is positioned on the base unit.

6. The apparatus of claim 4, in which the means for charging the second battery pack is inductively coupled to the charging interface circuit when the handset is positioned proximately to the base unit, such that energy can be magnetically transferred from the base unit to the portable unit.

7. The apparatus of claim 4, in which the controller circuit includes a microprocessor.

Application No: GB 0014698.5
Claims searched: 1 to 7
Examiner: Nik Dowell
Date of search: 23 November 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H2H - HAJ, HBCH H4L - LECTX

Int Cl (Ed.7): H02J - 7/00, 7/34, 9/00, 9/04, 9/06 H04B - 1/16 H04M - 1/73

Other: Online : WPI, EPODOC, PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2 279 827 A	(Vtech Communications) see fig 4	-
X	EP 0 433 605 A2	(Hagenuk) see abstract	1
X	US 5 912 514 A	(Smith Corona) see whole document	1
X	US 5 801 513 A	(Motorola) see whole document	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.